6.0 PLAN COMPARISON

Comparison of alternative plans is the fifth step in the planning process. In this step, the top candidate plans (the NER and the LPP) are compared in terms of their contributions towards the four accounts under the System of Accounts as suggested by the U.S. Water Resources Council. These include National Ecosystem Restoration (NER), Environmental Quality (EQ), Regional Economic Development (RED), and Other Social Effects (OSE). The top plans are then tested against the four specific evaluation criteria, which are Acceptability, Completeness, Effectiveness and Efficiency. The analyses will demonstrate which plan(s) would be the most rational choice for recommendation.

6.1 Comparison of Plan Features

All of the action alternatives require sediment removal from Bolinas Lagoon, some by hydraulic cutterhead dredge and some by land excavation, with disposal at a suitable site. Through the Incremental Cost Analysis, which compared increase in intertidal volume to cost, the most cost effective plans were identified. Out of the top three plans from the ICA, which were the North and South (No Seadrift); North and Central (Estuarine); and North, Central (Estuarine) and South (No Seadrift), one plan, the North, Central (Estuarine), and South (No Seadrift) plan was identified as the NER Plan. The North and South (No Seadrift) alternative plan was eliminated as a potential NER Plan, even though it was cost effective, because it was not considered a viable option, based on the acceptability, effectiveness and completeness criteria (discussed in Section 6.3). The North and Central (Estuarine) plan was eliminated for the same reason. Because the local sponsor wanted the public to comment on two plans, with two variations of the Pine Gulch Creek Delta restoration component, the local sponsor selected the North, Central (Riparian) & South (No Seadrift) plan as the LPP. Although similar to the NER, the LPP offers an alternative to the Pine Gulch Creek Delta Estuarine component. Based on public input, both the NER and the LPP are viable options. However, only one will be selected for recommendation in the final reports. All of the plans that were not cost effective were eliminated from further consideration, as one requirement for this project is to restore Bolinas Lagoon in a cost effective manner.

The NER Plan, the North, Central (Estuarine) and South (No Seadrift) alternative plan, and the LPP, the North, Central (Riparian) and South (No Seadrift) alternative plan, will be compared to one another and to the No Action plan in this chapter. The major difference between the NER and the LPP is the Pine Gulch Creek Delta area, where 7 out of 17 acres of riparian habitat would be removed with the NER, but would not be touched with the LPP. The benefits of each of these plans are comparable, but the NER is more expensive, by about $837,000. The major project features of the LPP are illustrated in Table 6.1, and the major project features of the NER Plan are illustrated in Table 6.2. Table 6.3 lists all major project costs. Project costs associated with the LPP and NER Plan are described in more detail in Chapter 7.

Table 6.1 Summary of the LPP North, Central (Riparian), and South (No Seadrift) Lagoon Alternative Excavation Volumes and Footprints

	Wet Material (barge) (cy)	Dry Material (truck) (cy)	Total Excavation Volume (cy)	Excavation Footprint (Acres)
Component	**SFDODS**	**Redwood**		
North Lagoon	674,800	0	674,800	174
Central Lagoon (Riparian)	656,700	14,300 + shrubs	671,000	230
South Lagoon (No Seadrift)	89,200	37,700 + trees/shrubs	126,900	26
Totals				
North, Central (Riparian), South (Without Seadrift)	**1,420,700**	**52,000 + trees/shrubs**	**1, 472,700**	**430**
Number of Disposal Trips	**1900**	**4,750**		

Table 6.2 Summary of the NER Plan North, Central (Estuarine), South (No Seadrift) Alternative Excavation Volumes and Footprints

	Wet Material (barge) (cy)	Dry Material (truck) (cy)	Total Excavation Volume (cy)	Excavation Footprint (Acres)
Component	**SFDODS**	**Redwood**		
North Lagoon	674,800	0	674,800	174
Central Lagoon (Estuarine)	663,500	39,600 + trees/shrubs	703,100	247
South Lagoon (No Seadrift)	89,200	37,700 + shrubs	126,900	26
Totals				
North, Central (Estuarine), South (Without Seadrift)	**1,427,500**	**77,300 + trees/shrubs**	**1,504,800**	**447**
Number of Disposal Trips	**1900**	**18,700**		

Table 6.3 Comparison of Project Costs

	LPP	NER Plan	No Action Plan
Dredging & Disposal Costs	$68,158,700	$68,781,700	$0
Land Construction	$4,997,700	$4,999,800	$0
Real Estate Costs	$2,031,400	$2,031,400	$0
Monitoring Costs^	$751,878	$758,129	$0
Adaptive Management Costs^	$2,255,634	$2,274,387	$0
Construction* Costs	$22,520,250	$22,707,480	$0
Total Project First Costs	$100,715,562	$101,552,896	$0
Interest During Construction	$32,446,323	$32,716,077	$0
Total Investment Cost	$133,161,885	$134,268,973	$0
Average Annual Cost (at 6.125%)	$8,156,165	$8,223,975	$0
Annual OMRR&R Costs**	$200,000	$200,000	$0
Total Annual Cost	$8,356,666	$8,424,476	$0

^Monitoring and adaptive management activities are described in Chapter 7, Sections 7.10 and 7.11.
*Construction costs, in this case, include Engineering & Design (E&D), Supervisory & Administration (S&A), and Escalation to the mid-point of construction.
**Operation, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R) is carried out for the life of the project once the cost-shared construction phase concludes. These requirements are described more fully in Chapter 5, Section 5.4.2.5 and Chapter 7, Section 7.12.

6.2 System of Accounts

A method of displaying the positive and negative effects of various plans is to use the System of Accounts as suggested by the U.S. Water Resources Council. The accounts are categories of long-term impacts, defined in such a manner that each proposed plan can be easily compared to another. The four accounts used to compare proposed water resource development plans are the national environmental restoration (NER), environmental quality (EQ), regional economic development (RED) and other social effects (OSE) accounts.

6.2.1 National Environmental Restoration (NER)

Ecosystem restoration measures used in formulating the National Ecosystem Restoration (NER) alternative plan are based on a combination of monetary and non-monetary benefits compatible with the Planning & Guidance (P&G) selection criteria as outlined in Engineering Regulation ER 1105-2-100, and include information about outputs, costs, significance, acceptability, completeness, effectiveness, and reasonableness of costs. There are no universal environmental outputs; however, the outputs must increase ecosystem value, productivity, and quantity & quality of measurable outputs. The outputs can include physical dimensions, population counts, habitat units (as described under the USFWS Habitat Evaluation Procedures), functional capacity units, or diversity indices.

Because ecosystem restoration projects do not use cost-based benefits in the cost-benefit comparison, there is no National Economic Development (NED) account for this project. As discussed in Chapter 5 (Plan Evaluation), the benefits of each alternative were in terms of increase in intertidal volume created, which translated into additional intertidal and subtidal habitat benefits. A brief synopsis of the results of the ICA, comparing the NER Plan, LPP and No Action Plan are displayed in Table 6.4.

Table 6.4 NER Account*

	LPP	NER Plan	No Action
Cost ($)	$118,894,540	$119,883,012	$0
Benefits (Annual Average cy)	2,381,558	2,393,713	None
Incremental Cost Per Unit (Annual Average cy)	$91.25	$90.548	$0

* Data from the Incremental Cost Analysis

6.2.2 Environmental Quality (EQ)

The environmental quality account is another means of evaluating the alternatives to assist in making a plan recommendation. The EQ account is intended to display the long-term effects the alternative plans may have on significant environmental resources. Significant environmental resources are defined by the Water Resources Council as those components of the ecological, cultural and aesthetic environments which, if affected by the alternative plans, could have a material bearing on the decision-making process. A comparison of the effects that the proposed plans may have on the EQ resources is shown on Table 6.5.

Table 6.5 Environmental Quality Account

	LPP	NER Plan	No Action Plan
Physical Environment			
Sedimentation & Erosion	Excavation in the Pine Gulch Creek Delta may increase the amount of sediment going into the lagoon in the short term. Overall, however, this alternative plan will remove many of the human-caused sedimentation impacts present in the lagoon. Rates of erosion in the watershed would not change.	Excavation in the riparian habitat area of the Pine Gulch Creek Delta may increase to a greater extent the amount of sediment going into the lagoon in the short term. Overall, however, this alternative plan will remove many of the human-caused sedimentation impacts present in the lagoon. Rates of erosion in the watershed would not change.	Sediment will continue to fill in the lagoon, and habitat values will diminish at an increasingly accelerated rate until at some point in the near future, intertidal and subtidal habitats will convert to dry land. Rates of erosion in the watershed would not change.
Flooding	No impacts	No impacts	No impacts
Water Quality	Short term impacts on turbidity likely. Potential long term benefits.	Short term impacts on turbidity likely. Potential long term benefits.	Water quality would continue to decrease.
Air Quality	Short term impacts from trucking and barging material for disposal likely. No long term impacts.	Short term impacts from trucking and barging material for disposal likely. No long term impacts.	No impacts
Noise	Short term impacts from dredging and excavating equipment below and above water line. No long term impacts.	Short term impacts from dredging and excavating equipment below and above water line. No long term impacts.	No impacts
Biological Environment			
Aquatic Habitat	Short term impacts from dredging, but large positive long term effects.	Short term impacts from dredging, but large positive long term effects.	Decreasing quality and quantity of aquatic habitat over time.
Riparian Habitat	Change to transition zone between riparian habitat and lagoon, but no major impacts.	Long term impacts from removal of 7 acres, but 10 acres would remain. Change to transition zone between riparian habitat and lagoon.	No direct impacts on riparian habitat, but quality of transition habitat would decrease over time.

	LPP	NER Plan	No Action Plan
Wetland Habitat	Short term impacts from construction, but overall, an increase in the amount of habitat available for wetland vegetation.	Short term impacts from construction, but overall, an increase in the amount of habitat available for wetland vegetation.	Decreasing quality and quantity of wetland habitat over time.
Upland Habitat	Long term impacts to upland habitat lagoon.	Long term impacts to upland habitat in lagoon.	Increasing quantity of upland habitat over time.
Endangered Species	Potential impacts on special status species in the Pine Gulch Creek Delta area. Otherwise, significant positive effect on threatened and endangered species.	Potential larger impacts on special status species in the Pine Gulch Creek Delta area. Otherwise, significant positive effect on threatened and endangered species.	Decreasing quality and quantity of habitat for endangered species over time.
Cultural Environment			
Cultural Resources	No impacts	No impacts	No impacts
Aesthetics	Large positive effect	Large positive effect	Decreasing quality of aesthetics over time.

6.2.3 Regional Economic Development (RED)

The regional economic development account is intended to illustrate the effects that the proposed plans would have on regional economic activity, specifically, regional income and regional employment. The comparison of possible effects that the plans may have on these resources is shown in Table 6.6.

Table 6.6 Regional Economic Development Account

	NER Plan	LPP	No Action Plan
Employment and Labor Force	8 – 9 year temporary increase in construction related employment.	8 – 9 year temporary increase in construction related employment.	No change expected
Business and Industrial Activity	N/A	N/A	N/A
Local Government Finance (State of California)	Implementation Cost of $133,161,885	Implementation Cost of $134,268,973	N/A

6.2.4 Other Social Effects (OSE)

The other social effects (OSE) account typically includes long-term community impacts in the areas of public facilities and services, recreational opportunities, transportation and traffic and man-made and natural resources. A comparison of the effects that the proposed alternatives would have on OSE resources is shown on Table 6.7.

Table 6.7 Other Social Effects Account

	LPP	NER Plan	No Action Plan
Public Health and Safety	Improvements due to improved habitat quality.	Improvements due to improved habitat quality.	No change expected
Public Facilities and Services	Improvements due to improved habitat quality.	Improvements due to improved habitat quality.	No change expected
Recreation and Public Access	Increased recreational opportunities due to improved habitat quality.	Increased recreational opportunities due to improved habitat quality.	Decreased recreational opportunities due to decreasing habitat quality.
Traffic and Transportation	No change expected	No change expected	No change expected
Man-Made Resources	N/A	N/A	N/A
Natural Resources	Improvements due to improved habitat quality.	Improvements due to improved habitat quality.	Decline in quality due to decreasing habitat quality.

6.3 Associated Evaluation Criteria

The candidate plans are compared using four formulation criteria suggested by the U.S. Water Resources Council. These criteria are completeness, effectiveness, efficiency and acceptability.

6.3.1 Completeness

Completeness is a determination of whether or not the plan includes all elements necessary to achieve the objectives of the plan. It is an indication of the degree that the outputs of the plan are dependent upon the actions of others. Both action alternative plans are complete conceptual lagoon restoration plans. None of these alternatives require any additional substantial features to accomplish the study objectives.

6.3.2 Effectiveness

Both the NER Plan and the LPP provide some contribution to the planning objectives. Effectiveness is defined as a measure of the extent to which a plan achieves its

objectives. Both action alternative plans are effective, to varying degrees, in increasing intertidal and subtidal habitat, increasing tidal prism, and decreasing the potential for inlet closure. The NER Plan has a slightly larger footprint than the LPP, but the plans can be considered comparable in their overall contribution to estuarine habitat benefits. Both plans meet all of the planning objectives for this study. The No Action Plan is not effective in meeting the planning objectives.

6.3.3 Efficiency

Both the NER and the LPP provide net benefits. Efficiency is a measure of the cost effectiveness of the plan expressed in net benefits. While both the NER Plan and the LPP are cost efficient, when comparing the benefits to the costs, the NER Plan is more efficient than the LPP. The No Action Plan maintains existing habitats, but fails to restore valuable habitats which have suffered historic losses, and which provide important habitat to many species. The No Action Plan represents a lost opportunity for improving environmental quality.

6.3.4 Acceptability

All of the plans in the final array must be in accordance with Federal law and policy. The comparison of acceptability is defined as acceptance of the plan to the local sponsor and the concerned public. The NER Plan and the LPP are acceptable, to varying degrees, to the local sponsor, local agencies, resource agencies, and involved groups and community members. Each plan provides a similar level of benefits, but they differ in the habitat areas that they impact. While either the NER Plan or the LPP could become the Recommended Plan in the Final Feasibility Report, this decision will depend on public acceptance as expressed through the public review process.

6.4 Trade-Off Analysis

The first trade-offs to be considered in evaluating the final alternative plans is to distinguish between the No Action Alternative and the action alternatives. This is followed by the trade-off between action alternatives.

6.4.1 Action Versus No Action

The No Action Plan ranks lower than the action alternatives in that it is not effective in meeting any of the planning objectives. It has no positive benefits or impacts, since it is the basis from which the impacts and benefits are measured. It does not, however, involve incurring the implementation cost of the action alternatives. Although there would be no short term impacts, there would also be no long term benefits associated with the No Action plan.

6.4.2 Trade-Offs between Action Alternatives

The second level of trade-offs to consider is between the two action alternatives. This trade-off analysis compares how the implementation of each alternative is distinguished from the other. The trade-offs considered include achievement of study planning objectives, economic benefits versus costs associated with implementation, and the environmental and other social effects associated with each alternative, as described earlier in this chapter. While these trade-offs are nearly identical for the NER Plan and the LPP, one feature sets them apart: the configuration of the Pine Gulch Creek Delta component. With the Riparian plan (LPP), none of the riparian habitat would be removed, thus favoring the riparian habitat over the estuarine habitat and the unique values it provides to the lagoon environment. With the Estuarine plan (NER Plan), 7 out of 17 acres of riparian habitat would be removed, favoring the estuarine habitat over the riparian habitat and the unique values it provides to the lagoon environment. The decision over which habitat type is more "valuable," or provides the largest overall benefit to Bolinas Lagoon, is a personal one, which is why the local sponsor has left that decision to the public.

6.5 Plan Selection

Selection of the recommended plan(s) is based on a number of criteria, including cost efficiency, cost effectiveness, NER, EQ, RED, OSE, completeness, effectiveness, efficiency, acceptability, and the trade offs between action plans, as discussed in Chapters 5 and 6. After the alternative plans are fully evaluated and compared, the top candidate plans are selected. In this case, there is an NER Plan and an LPP, both of which are the tentatively selected plans for the Draft Feasibility Report. Based on continuing coordination with the local sponsor, results of the public involvement/review process, and continuing refined evaluation of the restoration alternatives, a recommended plan will be identified for the Final Feasibility Report.

6.5.1 Rationale for Designation of the National Ecosystem Restoration (NER) Plan

The North, Central (Estuarine), and South (No Seadrift) alternative plan is the plan that reasonably maximizes net ecosystem restoration benefits by having the maximum amount of restoration benefits compared to costs. It is, therefore, designated as the National Ecosystem Restoration Plan.

6.5.2 Rationale for Designation of the Locally Preferred Plan (LPP)

The North, Central (Riparian), and South (No Seadrift) alternative plan has been selected by the local sponsor as the Locally Preferred Plan *not* because it is the locally preferred plan (as the name would suggest), but because the local sponsor wanted to present two potential plans for public review. This decision was based on concern over which Pine Gulch Creek Delta variation the local community would prefer.

6.5.3 Rationale for Designation of the Selected Plans

The local sponsor is concerned about choosing the plan that is most supported by the local community; therefore, the final recommended plan will not be selected until after public review of the draft report. It will be up to the public to choose which Pine Gulch Creek Delta variation is preferred. Based on the comments on the Draft Feasibility Report, one of the two final plans (either the LPP or the NER) will be recommended for implementation. The selected plan in the Final Feasibility Report will be the plan that best meets the needs of the local community. No matter what plan is chosen as the recommended plan in the final report, the Federal government will only cost share up to the cost of the NER Plan. If the recommended plan is more expensive, the local sponsor will be responsible for 100% of the excess cost of that plan. For this project, the cost of the LPP would most likely be less than the cost of the NER Plan.

A significant advantage of both the LPP and NER Plan is that they have numerous components addressing a variety of problem areas in the lagoon and encompassing the widest range of possible actions to address the lagoon's sedimentation problem. With a recommended plan this comprehensive, it is easy to extract separable elements for implementation at each dredging season. In addition, because temporary inlet closure is imminent, future inlet closure is warded off even further with the implementation of each sequential component. This would be especially advantageous if funding were to become limited in the future.

6.6 Risk and Uncertainty

Areas of risk and uncertainty are analyzed and described so that decisions can be made with knowledge of the degree of reliability of the estimated benefits and costs and of the effectiveness of alternative plans. Areas of risk and uncertainty are described in Table 6.8.

Table 6.8 Areas of Risk and Uncertainty

Area of Concern	Likelihood	Potential Impacts	Mitigation Measures
1. Disturbance to benthic communities	likely	Temporary/Short Term impact to benthic habitat	none
2. Failure to recruit benthos	low likelihood	Temporary disturbance to benthic communities and to feeding patterns of other species	Monitoring and adaptive management
3. Disturbance to species that feed in the water column (from turbidity)	likely	Temporary disturbance to water column species and species that feed on water column species	Require that construction equipment perform within certain thresholds; Monitoring and adaptive management
4. Decrease in water quality during construction	likely	Temporary disturbance to benthic communities; disturbance to water column species and species that feed on water column species; disturbance to feeding patterns of benthic species, fish, birds, and seals	Use only one dredge at a time; Require that construction equipment perform within certain thresholds; Limit dredging to certain months of the year to avoid major species activities; Monitoring and adaptive management
5. Noise disturbance to species in lagoon from dredge equipment	likely	Temporary disturbance in breeding, nesting and feeding patterns of fish, birds and seals	Use only one dredge at a time; Require that construction equipment perform within certain thresholds; Limit dredging to certain months of the year to avoid major species activities; Monitoring and adaptive management
6. Disturbance in migration patterns of anadramous fish from dredging activities	unlikely	Temporary decrease in the ability for salmon & steelhead to migrate to watershed creeks	Limit dredging to certain months of the year to avoid major species activities (i.e., NOT during migration periods)
7. Disturbance in breeding, nesting, and foraging patterns of migratory waterfowl from dredging activities	likely	Temporary disturbance in breeding, nesting and feeding patterns of migratory waterfowl due to dredging activity, water quality and noise levels	Use only one dredge at a time; Limit dredging to certain months of the year to avoid major species activities; Monitoring and adaptive management
8. Disturbance to pupping harbor seals from dredging activities	unlikely	Temporary disturbance to pupping habor seals in the lagoon	Limit dredging to certain months of the year to avoid major species activities (i.e., NOT during pupping season)